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NASA COOPERATIVE AGREEMENT

NCC 2-373

Investigation of Advanced Failure Modes Analyses and Tests for Harrier Digital Avionics

FINAL TECHNICAL REPORT

(NASA-CR-199707) INVESTIGATION OF  
ADVANCED FAILURE MODES ANALYSES AND  
TESTS FOR HARRIER DIGITAL AVIONICS  
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## CONTENTS

<u>Topic</u>	<u>Page</u>
Final Report - General Summary	1
Cumulated References	2

## NASA COOPERATIVE AGREEMENT NCC 2-373

Investigation of Advanced Failure Modes Analyses and Tests for Harrier Digital Avionics

### FINAL TECHNICAL REPORT

#### 1.0 General Summary

Work during the course of the above agreement resulted in eight open-literature publications. Cumulated references to these publications follows this general summary.

Primary USC effort under the grant was to collaborate with NASA-Ames scientists in two flight research programs: the V/STOL Systems Research Aircraft (VSRA) Project and the Ames RASCAL Project, an Army Blackhawk helicopter modified for advanced flight research..

Effort supporting the VSRA Project included:

- 1) Development of methods for performing quantitative risk assessment of airborne systems and ground facilities controls.
- 2) Preparation of a VSRA FMEA and Hazard Analysis (to assist in fault simulation).
- 3) Development of navigation algorithms.
- 4) Development of simulation models to be used in the VSRA Development Facility.
- 5) Derivation of plant models for the aircraft (A YAV-8B).
- 6) Development of a set of automated data gathering tools to support the general checkout of the simulation and the failure mode testing.
- 7) Development of menu-oriented methods for generating failure mode test data sets.
- 8) Assistance in development of a programmable display unit for driving a heads-up display unit.

Effort supporting RASCAL included:

- 1) Development of a helmet-mounted display.
- 2) Assistance in developing advance terrain-following and Nap-of Earth (NOE) algorithms.

## 2.0 Cumulated References

The following references were supported in part by the Agreement and include USC authors:

1. Dunn, W.R.; Doty, L.W.; Frank, M.V.; and Epstein, S.A.: Risk Assessment and Management of Safety-Critical, Digital Industrial Controls - Present Practices and Future Challenges. PSAM II Conference, San Diego CA, March 20-24, 1994.
2. Carroll, C.; Dunn, W.; Doty, L.; Frank, M.; and Hulet, M.: Reliability-Based Design of a Safety-Critical Automation System - A Case Study. PSAM II, San Diego CA, March 20-24, 1994.
3. W. Dunn; R. Folsom; and O. Green: Latent-Failure Risk Estimates for Computer Control. Reliability and Maintainability Symposium, Orlando FL, January 29-31, 1991.
4. Dunn, W. and Corliss, L.: Software Safety: A User's Practical Perspective. Reliability and Maintainability Symposium, Los Angeles, CA, January 23-25, 1990.

The following references collectively describe VSRA research results which were directly supported by USC personnel working under the Cooperative Agreement.

1. Franklin, J.A. and Stortz, M.W.: Flight Evaluation of Advanced Controls and Displays for Transition and Landing on the NASA V/STOL Systems Research Aircraft (VSRA), NASA TP publication in progress.
2. Stortz, M.W. and O'Donoghue, D.P.: V/STOL Systems Research Aircraft - A Tool for Cockpit Integration. 39th Symposium of the Society of Experimental Test Pilots. September 1995.
3. Watson, D.M. and Foster, J.D.: VSRA Systems Design and Lessons Learned. NASA TP publication in progress.
4. Dorr, D.W.; Moralez, E.; and Merrick, V.K.: Simulation and Flight Test Evaluation of Head-Up-Display Guidance for Harrier Approach and Transition. AIAA Paper 92-4233, August 1992.

References for the RASCAL Project were not available at the conclusion of the Cooperative Agreement. It is expected that several publications will be made in the future on this research program.